a' cont.

coil bobbin 62. An inner yoke 55 equipped with pole teeth 55a and an inner yoke 56 equipped with pole teeth 56a are disposed adjacent to one another between the coil bobbins 61 and 62. An outer yoke 57 equipped with pole teeth 57a and an outer yoke 58 equipped with pole teeth 58a are disposed outside in the axial direction of the coil bobbins 61 and 62. The outer yoke 57 is formed in a manner to cover the exterior side of the coil 61a, and the outer yoke 58 is formed in a manner to cover the exterior side of the coi162a, such that the outer yokes 57 and 58 respectively serve as an exterior casing of the motor. A rotor 52 having a rotor shaft 53 is disposed within an internal peripheral surface of the stator 51 opposite to the pole teeth 55a -58a. A cap 54 is attached to one end face of the stator 51. A bearing 54a is disposed in the cap 54 such that the bearing 54a supports one end of the rotor shaft 53.

Fig. 5 shows an exterior view of the stepping motor. Opening sections 57b and 58b are provided in the external yokes 57 and 58 that serve as the motor casing, respectively. The terminal section 63 protrudes from a window section that is formed by the opening sections 57b and 58b. The terminal section 63 has terminal pins 63a, 63c, 63b and 63d fixedly provided at equal intervals thereon. The terminal pin 63a is connected to a winding start section of the winding 61a, the terminal pin 63c is connected to a winding end section of the winding 61a, the terminal pin 63b is connected to a winding start section of the winding 62a and the terminal pin 63d is connected to a winding end section of the winding 62a.

The motor thus constructed in a manner described above has a structure in which, as shown in Fig. 6, one end of the rotor shaft is supported by a frame. A channel shaped frame 65 is affixed to a stator 51.

a' cont.

As described above, one end of the rotor shaft 53 of the rotor 52 is supported by a bearing that is formed in the cap 54 on one side of the stator 51, and the other end of the rotor shaft 53 passes through the stator 51 and protrudes to a great extent on the other side. In other words, the rotor shaft 53 of the rotor 52 passes through a passing aperture 71a that is formed in a plane section 71 of the frame 65 that is affixed to the stator 51, and one end of the rotor shaft 53 is supported on a bearing 73 that is mounted on a plane section 72 of the frame 65 that opposes to the plane section 71. An external peripheral surface of a section of the rotary shaft 53 that protrudes on the side of the frame 65 defines a lead screw section 67.

The motor having the structure described above is assembled in the following manner. First, the frame 65 is affixed to one end surface of the stator 51. Then, as shown in Fig. 7, one end of the rotor shaft 53 of the rotor 52 is inserted in the stator 51 on the side where the frame 65 is not mounted (in a direction indicated by the arrow in Fig. 7) .When the end of the rotor shaft 53 passes the internal surface of the stator 51 and the passing aperture 71a of the frame 65 and reaches the bearing 73 (see Fig. 6) that is mounted on the frame 65, the cap 54 is attached to the stator 51. In this manner, the motor is assembled.

In the motor having the structure described above, an exterior casing that encloses the exterior of the stator 51 is formed from external peripheral sections of the external yoke 57 equipped with the pole teeth 57a and the external yoke 58 equipped with the pole teeth 58a. The external casing has a relatively complex configuration, and is composed of two members that are divided up and down in the axial direction. In addition, connecting sections between the external yokes 57 and 58 are provided with the opening sections 57b and 58b, respectively. Therefore, when the external yokes 57 and 58 are disposed adjacent to each other in the axial direction, the opening

a' concl'd.

sections 57b and 58b need to be carefully aligned with each other. Accordingly, a mold for making the external casing has a complex configuration, and the assembly efficiency is poor.

Also, in the above-described motor, when one end of the rotor shaft 53 of the rotor 52 is passed through the internal empty space within the stator 51 and protruded on the side of the frame 65, and is supported by the bearing 73 that is mounted on the frame 65, there is a risk that the lead screw section 67 collides with an internal surface of the passing aperture 71a that is formed in the plane section 71 of the frame 65. In other words, when the works described above are performed, the rotor shaft 53 needs to be maintained perpendicular to the plane section 71, and the center of the rotor shaft 53 needs to coincide with the center of the passing aperture 71a. These tasks are very difficult. Moreover, there is only a small difference between the diameter of the passing aperture 71a formed in the plane section 71 that serves as an affixing surface of the frame 65 to be affixed to the stator 51 and an external diameter of the lead screw 67. In addition, since the passing aperture 71a is punched out by a press machine, edges of the aperture may have burrs. Therefore, unless the works are carefully conducted, the rotor shaft 53 could be inserted with its center being eccentric with respect to the passing aperture 71a, as shown in Fig. 7. As a result, the lead screw section 67 may come in contact with the internal surface of the passing aperture 71a and scrape the burrs, which may clog the male screw of the lead screw 67 or damage the male screw of the lead screw section 67. As a result, when the male screw of the lead screw section 67 is damaged, noise may be generated due to the damage in the lead screw section 67 when the motor is driven. When the male screw of the lead screw section 67 is clogged with burrs, noise may likewise be generated or the motor may become inoperable during its operation.

Please replace the two paragraphs at page 4, line 19 – page 5, line 20, with the following amended text:

a2

In accordance with an embodiment of the present invention, a motor has a stator including a coil bobbin with winding sections to be wound by windings and a terminal section that outwardly protrudes in a radial direction of the coil bobbin and has fixed protruded terminal pins that are to be connected to winding start sections and wiring end sections of the windings. In one aspect of the embodiment of the present invention, a curled case covers an exterior of the windings of the stator. The curled case may preferably be formed by curling a flat metal plate along a peripheral direction of the stator. The curled case has end sections in the peripheral direction and an opening section defined by the end sections of the curled case. The terminal section protrudes through the opening section, and the opening section may preferably open at an opening arc angle defined by less than one half of the entire periphery of a circle (i.e., less than 180 degrees). Since an exterior casing of the motor is formed from the curled case, the exterior casing can be readily manufactured and readily assembled. Also, since the opening section of the curled case is formed to be less than one half of the entire periphery of a circle (i.e., less than 180 degrees), the curled case is readily retained by, for example, external peripheral sections of the yokes when it is placed over the stator. The curled case can be readily affixed to the yokes by, for example, welding or the like.

In accordance with one embodiment of the present invention, the coil bobbin has a structure in which the winding sections that are to be wound by the windings are disposed adjacent to each other in the axial direction, and the curled case is welded to external peripheral sections of the yokes that are made of metal and disposed between the winding sections. The opening section of the curled case may preferably open at

a2 concl'd.

an opening arc angle defined by one third of the entire periphery of a circle or less (i.e., 120 degrees or less). As a result, the opening section is narrowed to improve formation of magnetic circuits, and the magnetic circuits are formed more effectively as the curled case is welded to the yokes, and therefore the motor characteristics can be improved.

Please replace the paragraph at page 6, lines 15-24, with the following amended text:

a3

In one aspect of the invention, the stator has a coil bobbin composed of a resin member and equipped with an aperture section disposed opposite to an external periphery of the rotor, and a yoke having pole teeth disposed opposite to the rotor. The yoke is integrally assembled with the coil bobbin by an insert forming method. The metal frame has a passing aperture that is disposed in a manner to overlap the aperture section of the coil bobbin for passing the rotary shaft. A cylindrical sleeve section that is formed integrally with the coil bobbin by a resin member is inserted in the passing aperture. The cylindrical sleeve section is provided at a peripheral edge of the aperture section of the coil bobbin.

Please replace the two paragraphs at page 8, line 23 – page 9, line 14, with the following amended text:

a4

The stator 1 has two coil sections 11 and 12 that are juxtaposed to each other in the axial direction. The rotor 2 is rotatably disposed inside the stator 1. Each of the coil sections 11 and 12, in their juxtaposed state, has an outer yoke 13 disposed on the outside of the stator 1 in the axial direction and an inner yoke 14 disposed on the inside of the stator 1 in the axial direction. In other words, the inner yokes 14 are disposed adjacent to each other. The yokes 13 and 14 are

a4 concl'd.

formed from magnetic metal members. Each of the yokes 13 and 14 has pole teeth 15 disposed on an internal peripheral side thereof opposite to an external peripheral surface of a magnet section 2a of the rotor 2.

The two pairs of the outer yokes 13 and the inner yoke 14 described above are formed with a coil bobbin in one piece by an insert forming method. A winding space for a winding 16 is provided between the outer yoke 13 and the inner yoke 14 in one of the pairs, and another winding space for a winding 17 is provided between the outer yoke 13 and the inner yoke 14 in the other of the pairs. The coil bobbin 18 is formed from a resin member, and has winding sections 19 and 20 disposed in the axial direction for winding the windings 16 and 17. The coil bobbin 18 also has an aperture section 24 in its internal peripheral wall that surrounds the periphery of the rotor 2. Surfaces of the pole teeth 15 are exposed through the aperture section 24 to the magnet section 2a of the rotor 2.

Please replace the paragraph at page 12, line 26 – page 13, line 12, with the following amended text:

a5

In the present embodiment, the curled case 28 is welded to the external peripheral sections of the inner yokes 14 by a laser welding or the like as a countermeasure to prevent the motor characteristic from deteriorating, which may be caused by magnetic flux leakage through the opening section. In one embodiment, the curled case 28 is welded to the inner yokes 14 at three locations. More specifically, the curled case 28 is welded to the inner yokes 14 at points A and C adjacent to the end sections 28a and 28b, respectively, and at a point C that is located about the center of the arc defined by the curled case 28, as shown in Fig. 3. in which the points A, B and C are generally evenly spaced from one another at an interval of about 110 degrees. As a result, the curled

a5 concl'd

case 28 is strongly bonded to the stator 1. In addition, as the curled case 28 is bonded to the inner yokes 14, magnetic paths can be independently formed at the coil sections 11 and 12 that are juxtaposed to each other in the axial direction. As a result, the magnetic paths become more effective and function to supplement the motor characteristic that may be lowered by the magnetic flux leakage.

Please replace the two paragraphs at page 14, line 4 – page 15, line 5, with the following amended text:

a6

The first plane section 31, which serves as a fixing surface to be affixed to the stator 1, has a passing aperture 31a for passing the rotor shaft 21 of the rotor 2. The cylindrical sleeve section 23 of the stator 1 extends into the passing aperture 31a. The cylindrical sleeve section 23 of the stator 1 may be pressure-inserted in the passing aperture 31a to thereby affix the frame 3 to the stator 1. Also, a circular hole is formed in the second plane section 32 of the frame 3, and a bearing 42 for supporting the end of the rotor shaft 21 is fixedly retained in the circular hole in the second plane section 32.

The cylindrical sleeve section 23 of the stator 1 can prevent damage that might otherwise be inflicted on the rotor shaft 21 by the frame 3 when the rotor 2 is inserted in the stator 1 with the lead screw section 21a being introduced as a leading section into the aperture section 24 from the side of the cap section 25 of the stator 1. In a conventional structure, when the rotor is inserted in the stator, a lead screw section may contact an internal peripheral section of the passing aperture formed in the frame, and may be damaged by the frame. However, in accordance with the embodiment of the present invention, the cylindrical sleeve section 23, which extends in the passing aperture 31a of the metal frame 3 that is affixed to the stator 1, is formed from a material that has a lower hardness than that of the lead screw section

a6 concl'd.

21a of the rotor shaft 21. In one embodiment, the cylindrical sleeve section 23 is formed with the coil bobbin 18 that is formed from a resin member in one piece, and placed in the passing aperture 31a of the metal frame 3. Therefore, when the lead screw section 21a is inserted through the passing aperture 31a of the metal frame 3 with its center being eccentric with respect to the center of the passing aperture 31a, the lead screw section 21a may contact the cylindrical sleeve section 23 that has a lower hardness but does not contact the passing aperture 31a of the metal frame 3. Since no damage is inflicted on the lead screw section 21a by the cylindrical sleeve section 23, excessive noise during sliding engagement with a head (not shown), which may be otherwise generated by damage inflicted on the lead screw section 21a, is prevented.

Please replace the paragraph at page 16, lines 13-27, with the following amended text:

a7

A preferred embodiment of the present invention is described above. However, the present invention is not limited to the embodiment described above, and many modifications can be made without departing the subject matter of the present invention. For example, in the above-described embodiment, the opening section of the curled case opens by about 90 degrees, and the curled case 28 is welded by a laser welding at three locations, i.e., adjacent to the end sections 28a and 28b and at the center of the curled case 28. However, the opening section can be opened wider or narrower than the embodiment. Also, in the above-described embodiment, the curled case 28 is welded to the inner yokes 14. However, in accordance with another embodiment, the curled case 28 may be additionally welded to the outer yokes 13. Furthermore, the curled case 28 may be welded at two locations adjacent to the end sections without welding at the

a7 cont'd.

center of the curled case 28, or may be welded at four or more locations along the periphery of the curled case 28 at equal intervals.

Please replace the two paragraphs at page 17, line 21 – page 18, line 12, with the following amended text:

a8

As described above, in accordance with the present invention, a motor has a stator including a coil bobbin with winding sections to be wound by windings and a terminal section that outwardly protrudes in a radial direction of the coil bobbins and has fixed protruded terminal pins that are to be connected to winding start sections and wiring end sections of the windings. A motor case is formed from a curled metal plate that extends along a peripheral direction of the stator and is placed over an exterior of the windings of the stator. The curled case has end sections in the peripheral direction and an opening section defined by the end sections of the curled case. The terminal section protrudes through the opening section, and the opening section may open at an opening arc angle of less than one half of the entire periphery of a circle (i.e., less than 180 degree). As a result, the curled case is readily retained by, for example, external peripheral sections of the yokes when it is placed over the stator. The curled case can be readily affixed to the yokes by, for example, welding or the like.

Also, the curled case is welded to external peripheral sections of the metal yokes that are disposed between the winding sections of the coil bobbin, and the opening section may have an opening arch angle of less than one third (1/3) of the entire periphery of a circle to thereby narrow the opening section. As a result, magnetic circuits are more effectively formed, and a higher motor characteristic can be obtained.